the first satellite to be rather brighter than the second." The diameters of the first and second satellites are about 1000 and 800 miles respectively, hence Herschel's comparative measures were correct.

R. A. GREGORY.

BABYLONIAN ASTRONOMY.[1]

I.

CLASSICAL writers seem to be unanimous in considering the Babylonians as the most ancient astronomers; a close examination shows, however, that the statement emanated from one or two writers, and that all the others merely repeated it without taking the trouble of verifying it. The figures given by various authors as to the period covered by the Babylonian astronomical observations are most extravagant, but the disagreement of the authors proves their inaccuracy. In spite of all discrepancies, one fact comes out clearly—that is, the Semitic origin of the Babylonian astronomy. Belus, the eponymic king of Babylon, considered by the classics as the first ruler or even the colonizer of Babylonia, is called the "inventor of astronomy," and Seneca considered the work of Berosus as a translation of that of Belus.

If we turn now to the native documents—the tablets now in the British Museum—we can class them under two distinct periods, those previous to the Greek rule and those contemporaneous with the Seleucids. Some tablets of the first period give us lists of certain astronomical or atmospheric observations, with the events which took place at the same time; the others are mere reports of the official astronomers stating what they observed, as the occurrence or non-occurrence of an eclipse. A characteristic point is that the observations are in no case dated: the day and the month are, indeed, given, but not the year; and this leaves no doubt as to the real character of these documents.

The Babylonians held the belief that the sky was a reflection of what was going on upon the earth: if, therefore, a certain event took place at the time of the conjunction of two stars, the same event would repeat itself when the same conjunction would take place. There were no predictions, but merely statements of real facts taking place at the same time in the sky and upon the earth, the actual date of which was of no consequence, as the object in view was to establish the supposed connection between what happened in the sky and what happened upon the earth—in short, correlative events. It appears also that the Babylonians admitted the existence of a cosmical year—that is, a period after which the same events were to occur again; this period was one of 360,000 years. The number was obtained by a mere play on figures. The basal number of the Semites was six, as the system used to form their numerals shows; by multiplying it by ten (the number of the fingers) they formed the *soss*, 60; by multiplying again by ten was formed the *ner*, 600; and the square of the former gave 3600, the *sar*, or "multitude." The cosmical year was supposed to be formed of 100 *sari*, or the square of the *ner;* this was probably the number given by Berosus to the antediluvian period, 10 *sari* being attributed to each king. From this number were derived those given by the classics as the period of the Babylonian astronomical observations—720,000 years (or two cosmical years) by Epigenes, 1,440,000 (or four cosmical years) by Simplicius; the 490,000 years given by Berosus, according to Pliny, represent one cosmical year and 130,000 years, elapsed in his opinion, of the actual period. It cannot be doubted, however, that the stars have been observed in Babylonia from a very high antiquity, for we have lists of eclipses for almost every day in the year, and as these eclipses actually took place, they prove a long period of observations; some of the astronomical statements also refer to the pre-Akkadian period—that is, earlier than 7000 B.C. If the Babylonians, in spite of this long period of observations, never arrived at any correct knowledge of the motion of the planets and stars, it is no doubt due to their deficient calendar.

Omen-taking being therefore the only object of the Babylonian astronomers, or rather star-gazers, they distributed the stars and planets under the direction of certain gods, according to the influence attributed to them. This has unfortunately thrown much confusion into their nomenclature, for the name of the god is sometimes taken for that of the star which he is supposed to influence, and the same god influences several; in some cases, also, the same star is sometimes under the influence of one god, sometimes under that of another. Besides this, we have many groups of seven stars: the seven *dibbu* or planets, the seven *masu* or double stars, the seven *zikru* or males, &c. The stars were also divided by regions—the twelve stars of the north, and the twelve stars of the south—and associated in groups of two with certain months; the months themselves were associated with certain regions, and were under the guidance of a god.

In all this we see the rudiments or rather germs of astrology; but, as astrology requires a knowledge of the movements of the planets, the Babylonians never arrived at this point—they merely took omens, and to do so they appear to have proceeded exactly as did the augurs of Rome. They described first in the sky a circle with their rod, divided this circle into eight divisions by lines passing through the centre, and then observed the position of the stars in this imaginary geometrical figure, and what kind of phenomena took place, in order to draw from them their omens. Having made his observation, the operator, or priest, then referred to the lists of omens, copies of which have come to us, to ascertain if the same celestial phenomenon had already been noted, expecting as correlative fact the same terrestrial event which had happened in the previous case.

It may be noticed, before concluding, that all the astronomical omen tablets recovered from Nineveh or Babylon are written in the Semitic language; there are no doubt a great many ideograms, but the phonetic complements, the words spelt phonetically, and the grammatical peculiarities show that the idiom used must be Semitic.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DUBLIN.—At the Summer Commencements of the University of Dublin, held in Trinity College, Dublin, on June 27, Mr. F. W. Burbidge, Curator of the Trinity College Botanical Gardens, received the honorary degree of M.A. The Public Orator, Prof. Palmer, called attention to the benefits conferred on botanical science by Mr. Burbidge, by his travels in Borneo, and by his labours in elucidating the natural history of those classic flowers the Narcissi and the Hellebores. The honorary degree of LL.D. was conferred on Mr. Valentine Ball, F.R.S., the Director of the Science and Art Museum, Dublin, and at one time Professor of Geology and Mineralogy in Trinity College, Dublin, whose works on the geology and mineralogy of India, and researches on the identification of the animals and plants of India which were known to the early Greek authors, merited the eulogium pronounced on them by the Orator.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, June 6.—Mr. Carruthers, F.R.S., President, in the chair.—Dr. John Anderson, Mr. J. G. Baker, Dr. Braithwaite, and Mr. F. Crisp, were nominated Vice-Presidents.—Prof. Martin Duncan exhibited under the microscope some beautifully mounted preparations of the ambulacral tentacles of *Cidaris papillata*, and drew attention to the fact, previously unrecorded, that the tentacles of the abactinal region of the test differ in form and character from those of the actinal region. The latter have a well-developed terminal disk, and are richly spiculated; whereas the former have no disk, but terminate distally in a pointed extremity with very few spiculæ. Mr. W. P. Sladen made some remarks on the significance of this dimorphism with reference to its archaic character, and its relation to the primitive forms of Echinoids and Asteroids.—Mr. Narracott exhibited a singular fasciated growth of *Ranunculus acris*, found at Castlebar Hill, Ealing.—Mr. H. B. Hewetson exhibited under the microscope a parasite of Pallas's Sand Grouse (*Syrrhaptes paradoxus*) taken from a bird shot in Yorkshire, and described as a species of *Argas*. Mr. Harting pointed out that an apparently different parasite from the same species of bird had been recently described by Mr. Pickard Cambridge (*Ann. Mag. Nat. Hist.*, May 1889) under the name *Hæmaphysalis peregrinus*.—Dr. Cogswell showed some examples of Jerusalem Artichoke and Potato, to illustrate the spiral development of the shoots from right to left.—Governor Moloney, of the colony of Lagos, exhibited a large collection of birds and insects from the Gambia, the result of twelve months' collecting in 1884-85. The birds, belonging to 134 species, had been examined and named by Captain Shelley. Amongst the beetles, of which 89 species had been collected, he called attention specially to *Galerita africana* and *Tefflus megelii*, and to the Rhinoceros and Stag-horned Beetles. Of butterflies there were 90 species, amongst which the most noticeable and characteristic were the *Acreas* and the pale-green *Eronia thalassina*, said to be typically Gambian. The moths, of which some 220 species had been brought home, were named by Mr. Herbert Druce, and several had proved to be new or undescribed. A portion of this collection had been exhibited at the Indian and Colonial Exhibition of 1886, but had since been carefully gone over and named, and was now exhibited for the first time in its entirety.—Mr. Herbert Druce alluded to some of the Lepidoptera which are most characteristic of the Gambia region; and Mr. Harting made some remarks upon the birds, pointing out the wide geographical range of some of the species which had been collected.—Mr. Clement Reid exhibited several specimens of fossil plants from a newly-discovered Pleistocene deposit at South Cross, South-elmham, near Harleston.—Mr. D. Morris exhibited specimens of the fruit of *Sideroxylon dulcificum*, the so-called "miraculous berry" of West Africa, belonging to the *Sapotaceæ*. Covered externally with a soft sweet pulp, it imparts to the palate a sensation which renders it possible to partake of sour substances, and even of tartaric acid, lime-juice, and vinegar, and to give them a flavour of absolute sweetness. The fruit of *Thaumatococcus* (*Phrynium Danielli*), possessing similar properties, was also shown; and living plants of both had lately been received at Kew from Lagos through Governor Moloney.—Mr. Thomas Christy exhibited growing plants of *Antiaris toxicaria* (the Upas-tree) and *Strophanthus Kombe*, both of them poisonous, to show the similarity of the foliage.—On behalf of Dr. Buchanan White, a paper was then read by Mr. B. D. Jackson, entitled a "Revision of the British Willows."

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[1] Abstract of the first lecture delivered by Mr. G. Bertin at the British Museum.

Royal Meteorological Society, June 19.—Dr. W. Marcet F.R.S., President, in the chair.—Mr. W. Marriott gave a very graphic and interesting account of the recent thunderstorms which have prevailed over this country. On Sunday, June 2, a thunderstorm passed across the country in a northerly direction from Wiltshire about 5 a.m., and reached Edinburgh by 10.44. It travelled at the rate of about 50 miles an hour. It is possible that this storm travelled still further north, and reached Kirkwall at 3.37 p.m. A severe thunderstorm prevailed over the neighbourhood of the Tweed between 11 a.m. and noon, and was accompanied by hail of very large size, some of the stones being 5 inches in circumference. A very destructive storm occurred over the whole of the north-west of England and south of Scotland during the afternoon; much damage was caused by lightning, and very large hail fell over an extensive area. Some of the hailstones measured 7 inches in circumference and weighed 7 ounces. During the night of the same day a severe thunderstorm prevailed over Norfolk, which was also accompanied by very large hailstones, some of which were 5 to 6 inches in circumference. On Thursday, the 6th, thunderstorms prevailed during the afternoon over the whole of the south-east of England; that which passed over the Metropolis about 9 o'clock was remarkable for the brilliant and continuous display of lightning. During the same night and in the early morning of the following day a very destructive storm prevailed over the Eastern Counties, much damage being done by the lightning in the north-west of Norfolk. Severe hailstorms occurred between 2 and 3 a.m., both at Margate and Ipswich. During the afternoon of the 7th, destructive thunderstorms prevailed over the whole of the Southern Counties, much damage being done by lightning, while at Tunbridge Wells there was a most remarkable hailstorm. One of the hailstones which was weighed was actually half a pound in weight. An interesting collection of over forty photographs of lightning taken during the storm on June 6 was also exhibited to the meeting. In addition to the sinuous, ribbon, and meandering flashes of lightning, several photographs showed knotted, multiple, and dark flashes.—The following papers were also read:—The climate of British North Borneo, by Mr. R. H. Scott, F.R.S.—On the variation of the temperature of the air in England during the period 1849 to 1888, by Mr. W. Ellis.—Atlantic weather and rapid steamship navigation, by Mr. C. Harding.—Meteorological phenomena observed during 1875-87 in the neighbourhood of Chelmsford, by Mr. Henry Corder.—Rainfall in China, and meteorological observations made at Ichang and South Cape in 1888, by Dr. W. Doberck.

Geological Society, June 5.—Prof. J. W. Judd, F.R.S., Vice-President, in the chair.—The following communications were read:—Observations on some undescribed lacustrine deposits at Saint Cross, Southelmham, in Suffolk, by Charles Candler (communicated by Clement Reid). Some remarks were made on this paper by Mr. Clement Reid, Prof. Prestwich, and Mr. Lydekker.—On certain Chelonian remains from the Wealden and Purbeck, by R. Lydekker. In the first part of the paper the author described a portion of the hind lobe of a Chelonian plastron from the Wealden, which was remarkable as showing a median row of epidermal shields. The name of *Archæochelys valdensis* was proposed for the form so represented. The new generic term *Hylæochelys* was also proposed for the Purbeck Chelonian described by Sir R. Owen as *Pleurosternum latiscutatum*, and was also taken to include some other forms from the Wealden. The second section of the paper treated of the affinities of *Pleurosternum*. It was concluded that *Digerhhum*, Cope (as represented by the so-called *Piatemys Bullocki*), is identical with *Pleurosternum*, of which there appears to be only one Purbeck species. Evidence was brought forward to show that in the adult of *Pleurosternum* the pubis had a facet for articulation with the xiphiplastral; and it was proposed to refer this genus, together with *Platychelys* and *Baëna*, to a new section termed "Amphichelydia," which was regarded as allied both to the true Cryptodira and to the Pleurodira.—On the relation of the Westleton Beds or Pebbly Sands of Suffolk to those of Norfolk, and on their extension inland; with some observations on the period of the final elevation and denudation of the Weald and of the Thames Valley, by Prof. Joseph Prestwich, F.R.S. The author in this, the first part of his paper, described the Westleton beds of the East Anglian coast. He commenced with a review of the work of previous writers, especially Messrs. Wood and Harmer, and the members of H.M. Geological Survey, including Messrs. H. B. Woodward, Whitaker, and Clement Reid. In discussing this work, particular attention was paid to the Bure Valley beds, which were considered as a local fossiliferous condition of the Pebbly Sands; but the term is not so applicable to these sands as that of the "Westleton and Mundesley Beds," which the author proposed in 1881. The Westleton beds were carefully described, as seen in coast-sections in East Anglia, proceeding from south to north, and the following classification was adopted:—

The Westleton and Mundesley series (The Mundesley section of it).	1. Laminated clays, sand, and shingle with plant-remains and freshwater shells (the Arctic forest-bed of Reid). 2. Sand and quartzose shingle with marine shells (the *Leda myalis* bed of King and Reid). 3. Carbonaceous clay and sands with flint-gravel and pebbles of clay, driftwood, land and lacustrine shells and seeds (the Upper freshwater bed of Reid).
The Forest-bed series of Reid (exclusive of No. 3 of above).	4. A greenish clay, sandy and laminated in places, containing abundant mammalian remains, and driftwood, with stumps of trees standing on its surface (the forest- and elephant-bed of authors; the estuarine division, in part, of Reid). 5. Ferruginous clay, peat, and freshwater remains and gravel (the Lower freshwater bed of Reid).

The Westleton beds were found to rest with discordance on various underlying beds; in places on the Forest series, elsewhere on the Chillesford Clay, whilst occasionally the latter had been partly or entirely eroded before the deposition of the Westleton beds. In the north, where the present series dies out, they come in contact with the so-called Weybourn Crag, which the author supposed to be the equivalent of the Norwich Crag. A similar discordance has been noted between the Westleton beds and the overlying glacial beds, so that the former mark a distinct period, characterized by a definite fauna, and by particular physical conditions. The Westleton beds being marine, and the Mundesley beds estuarine and freshwater, the author proposed to use the double term to indicate the two facies, as has been done in the case of other deposits. But these facies were found to be local, and the most persistent feature of the beds is the presence of a shingle of precisely the same character over a very wide area. By means of this the Westleton beds can be identified far beyond East Anglia, and where there is no fossil evidence, and they throw a considerable light on important physiographical changes. The author described the composition of the shingle, which, unlike the glacial deposits, contained pebbles of southern origin. The paper concluded with a list of fossils, excluding those of the Forest-bed (the stumps of which, the author considered, were frequently in the position of growth). Should the Forest-bed eventually prove to be newer than the Chillesford beds, it was maintained that the former must be included in the Westleton series, and its flora and fauna added to the list, whilst if, on the contrary, the Forest-bed should be proved synchronous with the Chillesford beds it must be relegated to the Crag. The second part of this paper will treat of the extension of these beds into and beyond the Thames Valley, and on some points connected with the physical history of the Weald. The reading of this paper was followed by a discussion, in which Mr. B. H. Woodward, Mr. J. A. Brown, and Mr. Topley took part.

June 19.—Prof. J. W. Judd, F.R.S., Vice-President, in the chair.—The following communications were read:—On tachylyte from Victoria Park, Whiteinch, near Glasgow, by Frank Rutley.—The descent of *Sonninia* and of *Hammatoceras*, by S. S. Buckman.—Notes on the Bagshot Beds and their stratigraphy, by H. G. Lyons.—Description of some new species of Carboniferous Gasteropoda, by Miss Jane Donald; communicated by J. G. Goodchild.—*Cystechinus crassus*, a new species from the Radiolarian marls of Barbados, and the evidence it affords as to the age and origin of those deposits, by J. W. Gregory.—The next meeting of the Society will be held on Wednesday, November 6.

Zoological Society, June 18.—Prof. Flower, F.R.S., President, in the chair.—The Secretary exhibited (on behalf of Mr. J. F. Green) a very fine example of the Common Eel, obtained from a pond in Kent, and measuring upwards of 4 feet in length.—Mr. B. B. Woodward exhibited, and made remarks on, a drawing representing a living example of *Ærope kaffra*, a carnivorous snail from the Cape Colony.—Mr. Woodward also exhibited an example of a fossil shell from the Eocene of the Paris Basin (*Neritina schmideliana*), and a section of it showing the peculiar mode of its growth.—Mr. Eadweard Muybridge, of the University, Pennsylvania, exhibited a series of projections by the oxyhydrogen light, illustrative of the consecutive phases of movements by various quadrupeds while walking, trotting, galloping, &c., and of birds while flying.—A communication was read from Prof. Henry H. Giglioli, containing the description of a supposed new genus and species of Pelagic Gadoids from the Mediterranean, proposed to be called *Eretmophorus kleinenbergi*.—Lieut.-Colonel H. H. Godwin-Austen, F.R.S., read the first of a proposed series of papers descriptive of the land-shells collected in Borneo by Mr. A. Everett, with the descriptions of new species. The present paper treated of the *Cyclostomaceæ*.—Captain G. E. Shelley read a list of birds collected by Mr. H. G. V. Hunter in Masai Land during the months of June, July, and August 1888. The collection (which Mr. Hunter had presented to the British Museum) consisted of examples of ninety-four species, seven of which were described by the author as new to science.—Mr. P. L. Sclater, F.R.S., gave a further description of Hunter's Antelope (*Damalis hunteri*) from specimens obtained by Mr. H. C. V. Hunter on the River Tana, Eastern Africa.—Mr. F. E. Beddard read a paper on the fresh-water and terrestrial Annelids of New Zealand, with preliminary descriptions of new species.—A communication was read from Mr. H. W. Bates, F.R.S., containing descriptions of some new genera and species of Coleopterous insects collected by Mr. Whitehead during his recent visit to Kina Balu. The collection was stated to comprise an unusual proportion of new and remarkable forms.—This meeting closed the session. The next session (1889–90) will begin in November 1889.

Victoria Institute, July 1.—Annual Meeting.—Sir George Stokes, Bart., P.R.S., President, in the chair.—After the reading and adoption of the Report, an address by Prof. Sayce was read by Dr. Wright. It gave a description of what has become known as to the conquests of Amenophis III., the palace and its archives, which have only lately been discovered, and which Prof. Sayce went last winter to investigate on the spot. Of the tablets and inscriptions, he said:—"From them we learn that in the fifteenth century before our era—a century before the Exodus—active literary intercourse was going on throughout the civilized world of Western Asia, between Babylon and Egypt and the smaller States of Palestine, of Syria, of Mesopotamia, and even of Eastern Kappadokia. And this intercourse was carried on by means of the Babylonian language, and the complicated Babylonian script. This implies that, all over the civilized East, there were libraries and schools where the Babylonian language and literature were taught and learned. Babylonian, in fact, was as much the language of diplomacy and cultivated society as French has been in modern times, with the difference that, whereas it does not take long to learn to read French, the cuneiform syllabary required years of hard labour and attention before it could be acquired." A vote of thanks was passed to Prof. Sayce for his address, to Dr. Wright for reading it, and to the President.

PARIS.

Academy of Sciences, June 24.—M. Des Cloizeaux, President, in the chair.—On the condition of matter near the critical point, by MM. L. Cailletet and E. Colardeau. The series of experiments here described, and carried out for the purpose of testing the views of Cagniard de Latour, Andrews, Ramsay, and other physicists, tend to show that the critical temperature of a liquefied gas is not that at which the fluid is totally evaporated abruptly within the space containing it, for the liquid state persists beyond this temperature; nor is it the temperature at which a fluid and its saturated vapour have the same density; but it is the temperature at which a fluid and the gaseous atmosphere above it become capable of being mutually dissolved in any proportion, so as to form, when shaken, a homogeneous mixture. This interpretation of the critical point supplies some interesting data on the unbroken continuity of the liquid and gaseous states of matter.—On the heat of formation of the hyponitrites, by M. Berthelot. M. Maquenne's experiments on the hyponitrites, here communicated to the Academy by M. Berthelot, seem to decide the question of the formula of hyponitrous acid, which corresponds with the percentage composition suggested by Divers, but with twice the molecular weight. The complete analysis of the salts of calcium and strontium removes all further doubt on this point.—Restoration of the skeleton of Dinoceras, by M. Albert Gaudry. The specimen here described is that of Marsh's *D. mirabile*, copies of which have been supplied both to the British Museum and to the new gallery of palæontology in the Paris Museum.—On the mastodons found at Tournan, Gers, by M. Albert Gaudry. The numerous remains of mastodons recently found by M. Marty in the Middle Miocene of Tournan, all belong to *M. angustidens*. Amongst them is the most perfect head of any mastodon yet brought to light in Europe. This, with some other important parts, has been secured for the Paris Museum, and affords facilities for determining the specific differences between *M. angustidens* of the Miocene and the *M. americanus* of the Quaternary epoch.—On the occlusion of gases in the electrolysis of the sulphate of copper, by M. A. Soret. Having already shown (*Comptes rendus*, November 5, 1888) that certain relations exist between the quantities of gas occluded in electrolytic copper and the conditions of temperature and acidity of the electrolyte, the author has carried out some further experiments leading to more accurate results, and throwing some light on the action of the electrolysis in this particular case. He finds that the electrolytic copper contains carbon dioxide and hydrogen, the latter of which is in most cases present in largest proportion (five-sixths may be taken as an average), and in all cases when the electrolyte is acid; further, that the brittleness of the deposit of copper is related to the presence of carbon dioxide.—On the compounds of ruthenium and ammonia, by M. A. Joly. The author has already shown that the constitution of the red chlorides of ruthenium was more complex than was supposed by Claus. It results from his further researches that the chloride and all bodies derived from it contain an atom of nitrogen more than was indicated by Claus, and that their formula might be written thus: $Ru . NO . OH . X_2(4NH_3)$.—On the presence of sulphate of soda in the atmosphere, and on the origin of saline dust, by M. P. Marguerite-Delacharlonny. Some facts are here adduced which may give a more general and perhaps a more correct explanation of the presence of the sulphate of soda in the atmosphere than that of M. Parmentier.—Camphor and borneol of rosemary, by M. A. Haller. A new method is described for separating these substances.—Mean altitude of the continents and mean depth of the oceans, by M. A. de Tillo. From the author's minute researches it results that the numerical data hitherto accepted by various authorities require to be modified. He finds the mean elevation of all the continents above sea-level to be 693 metres : northern hemisphere, 713 ; southern hemisphere, 634 ; Europe, 317 ; Asia, 957 ; Africa, 612 ; North America, 622 ; South America, 617 ; Australia, 240. Mean depths of all the oceans, 3803 : Pacific, 4380 ; Atlantic, 4022 ; Indian, 3674 ; northern seas, 3627 ; southern seas, 3927.

BERLIN.

Physical Society, June 7.—Prof. von Helmholtz, President, in the chair.—Dr. R. von Helmholtz communicated the results of his experiments on the radiating power of flames. The problem which he had set before himself was to determine the relationship between the radiant energy of flames, and the amount of gas consumed for their production. The latter was measured by the fall of the gasometer-globe which contained the gas, the former by means of a bolometer, for each of whose scale-divisions the equivalent value in heat-units had been carefully determined by three different methods. The radiating energy of the flames depended upon a number of conditions which were each severally investigated ; as, for instance, the size and shape of the flames, the amount of foreign gases introduced, and the ratio of the amount of oxygen to the amount of gases with which it was mixed. For the purposes of comparative measurements, a moderately high flame was chosen, which produced no smoke and was 6 mm. thick. Luminous flames radiated more energy than non-luminous, and it was proved by an extended series of careful quantitative experiments that the radiating power of the flames was not dependent upon their temperature. From this it follows that Kirchoff's law does not hold good for flames—a result which is, however, quite in accordance with the limitations he put to his law for those cases in which heat is directly converted into radiating energy. In the case of flames it must be borne in mind that chemical affinity comes additionally into play : the speaker entered fully into the influence of this upon the radiation of energy, and endeavoured to make it clear by means of an extremely interesting hypothesis. After this he stated the numerical data which he had obtained for both luminous and non-luminous flames, produced with a series of gases—hydrogen, carbonic oxide, methane, coal-gas, methyl-alcohol, &c. Starting as a basis with Julius's statement that the products of combustion are the only criteria of the amount of radiation, and hence calculating the radiating energy of the flames, he obtained values which corresponded very closely in most cases with those actually observed. Finally he calculated the total useful effect which can be obtained as radiant energy from the gases which are being consumed in the production of the flame. From this he arrived at the interesting result that it is far more economical to use the gases for driving a dynamo which supplies incandescent lamps, and to utilize the energy radiated from the latter, than to burn the gases, and utilize the energy which is radiated out from their non-luminous flames. The communication, as a whole, of which only a short sketch has here been given, contained a large number of very valuable quantitative results.—Dr. Budde spoke on "tautological" contacts in mechanics, and deduced the general conditions under which a close determination of contacts between surfaces and points is unnecessary ("tautological").

Physiological Society, June 14.—Prof. Munk, President, in the chair.—Dr. Openchowski spoke on the researches which he has carried on since 1883 on the movement and innervation of the stomach. The movements were recorded by introducing into the stomach a small bag filled with water and connected with a manometer, the motion of the column of fluid in the latter being recorded graphically. The fundus and first third of the stomach never exhibit any spontaneous peristaltic movements, these being confined to the second and last third, including the pylorus. The centre for the initiation of the motor movements lies in the ganglion cells under the serous coat which extend all over the stomach along the branches of the vagus nerve. The motor and inhibitory centres on which the movements of the cardiac end depend are situated in the brain and spinal cord ; the motor centres lie in the corpora quadrigemina and in the spinal cord between the fifth and eighth thoracic vertebræ ; the inhibitory centres lie in the corpus striatum, and a few are scattered in the spinal cord. The connection between the cranial centres and the stomach is provided by the vagi ; there is no connection between the cranial and spinal centres. The centres for the pyloric end are situated in the same places as those for the cardiac end, but the centres which are inhibitory for the latter are motor for the former, and *vice versâ*. The speaker has studied the act of vomiting very fully. The stomach plays an active part in this act. After paralysis of the stomach, the movements of vomiting may be brought about, but do not lead to an ejection of the stomach's contents. After administering an emetic, such as sulphate of copper, the fundus and first third of the stomach is actively dilated ; the pylorus is at the same time relaxed, and the contents of the small intestine are driven into the stomach by the contraction of the intestinal walls, and then, by the strong and progressive contractions of the last two-thirds of the stomach, they are driven on into the first third of the stomach. At this stage the stomach has a pear-like shape, the fundus being unduly distended. The reflex movements of vomiting now occur, and the pressure exerted by the abdominal muscles leads to the emptying of the highly distended fundus. As after paralysis of the stomach, so also after section of the vagi and excision of the stomach and intestines, the movements of vomiting occur when an emetic is administered. No *single* centre for vomiting appears to exist and be actively functional during the act, but there would seem rather to be a combination of co-ordinated centres, whose position has still to be more definitely ascertained.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

U.S. Commission of Fish and Fisheries, 4 vols. : G. Brown Goode.—Inorganic Chemistry : Ira Remsen (Macmillan).—Eclipses and Transits in Future Years : S. J. Johnson (Parker).—Fundamental Problems : Paul Carus (Open Court Publishing Company).—Rendiconti del Circulo Matematico (Palermo).—Avifauna Italica, parte prima : E. H. Giglioli (Monnier, Florence).—Injurious Farm and Fruit Insects of South Africa : E. A. Ormerod (Simpkin).—Gaseous Fuel : B. H. Thwaite (Whittaker).—Electricity : A. Rust (Spon).—American Resorts : B. W. James (Davis).—The Prospector's Hand-book, 4th edition : J. W. Anderson (Lockwood).—*Phormium tenax* as a Fibrous Plant, 2nd edition ; edited by Sir J. Hector (Wellington, New Zealand).—Geology in Systematic Notes and Tables, 2nd edition : W. F. Gwinneli (Allman).—Kant's Critical Philosophy, vol ii. The Prolegomena ; translated : J. P. Mahaffy and J. H. Bernard (Macmillan).—Physics of the Earth's Crust, 2nd edition : Rev. O. Fisher (Macmillan).—Schriften der Naturforschenden Gesellschaft in Danzig ; Neue Folge, Siebenten Bandes, Zweites Heft (Danzig).—Observations made at the Blue Hill Meteorological Observatory, Mass., U.S.A., 1887 : A. L. Rotch (Camb., Mass.).—Transactions and Proceedings of the New Zealand Institute, vol. xxi. (Trübner).

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